TB 9-6625-2271-35

DEPARTMENT OF THE ARMY TECHNICAL BULLETIN

CALIBRATION PROCEDURE FOR AUDIO ANALYZER BOONTON, MODEL 1120-S/10

Headquarters, Department of the Army, Washington, DC
25 November 1991

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SECTION I

IDENTIFICATION AND DESCRIPTION

1. Test Instrument Identification. This bulletin provides instructions for the calibration of Audio Analyzer, Boonton, Model 1120-S/10. The manufacturer's manual and specifications provided with Calibration and Repair Requirements Worksheet were used as the prime data sources in compiling these instructions. The equipment being calibrated will be referred to as the TI (test instrument) throughout this bulletin.

a. Model Variations. None.

b. Time and Technique. The time required for this calibration is approximately 6 hours, using the dc and low frequency .

2. Forms, Records, and Reports

a. Forms, records, and reports required for calibration personnel at all levels are prescribed by TB 750-25.

b. Adjustments to be reported are designated (R) at the end of the sentence in which they appear. When adjustments are in tables, the (R) follows the designated adjustment. Report only those adjustments made and designated with (R).

3. Calibration Description. TI parameters and performance specifications which pertain to this calibration are listed in table 1.

Table 1. Calibration Description

Test instrument parameters	Performance specifications
Dc level measurement	Range: 3, 30, 300 V FS Accuracy: ±1% or (3 counts) whichever is greater
Ac level measurement	Range: 3, 30, 300 mV and 3, 30, 300 V Range: 50 Hz to 50 kHz (1 mV to 300 V) Accuracy: ±1% Range: 20 to 50 Hz and 50 to 100 kHz (1 mV to 300 V) Accuracy: ±2% Range: 10 to 20 Hz[1] (1 mV to 300 V) Accuracy: ±3% Range: 10 Hz to 100 kHz (.3 to 1 mV)[2] Accuracy: ±4%
Frequency counter	Range: 20 Hz to 100 kHz Sensitivity: < 5 mV
Audio filters	Range: 30 kHz low-pass Accuracy: ±2 kHz Range: 80 kHz low-pass Accuracy: ±4 kHz Range: 220 kHz Accuracy: ±20 kHz
Distortion measurement	Range: 20 Hz to 20 kHz Accuracy: ±1 dB Range: 20 to 100 kHz Accuracy: ±2 dB
Output frequency	Range: 20 Hz to 100 kHz Accuracy: ±1%
Output level flatness	Range: 20 Hz to 20 kHz, 0.6 mV to 6 V Accuracy: ±0.7% Range: 20 to 100 kHz, 0.6 mV to 6 V Accuracy: ±2.5%

See footnotes at end of table.

Table 1. Calibration Description - Continued

Test instrument parameters	Performance specifications
Output distortion	Range: 20 Hz to 20 kHz, 80 kHz bandwidth Accuracy: < -80 dB Range: 20 to 100 kHz, 500 kHz bandwidth Accuracy: < -65 dB

[1]Not checked below 20 Hz.
[2]Not verified.

SECTION II

EQUIPMENT REQUIREMENTS

4. Equipment Required. Table 2 identifies the specific equipment to be used in this calibration procedure. This equipment is issued with both Secondary Transfer Calibration Standards Set AN/GSM-287 and Secondary Reference Calibration Standards Set NSN 4931-00-621-7878. Alternate items may be used by the calibrating activity. The items selected must be verified to perform satisfactorily prior to use and must bear evidence of current calibration. The equipment must meet or exceed the minimum use specifications listed in table 2. The accuracies listed in table 2 provide a four-to-one ratio between the standard and TI.

5. Accessories Required. The accessories required for this calibration are common usage accessories, issued as indicated in paragraph 4 above, and are not listed in this calibration procedure.

Table 2. Minimum Specification of Equipment Required

Common name	Minimum use specifications	Manufacturer and model (part number)
CALIBRATOR	Range: 3 to 300 V dc Accuracy: ±0.275% Range: 20 Hz to 100 kHz, 3 mV to 300 V Accuracy: ±0.25%	John Fluke, Model 5700A/CT (p/o MIS-35947), w/power amplifier; John Fluke, Model 5215A/CT (5215A/CT), w/ac divider, John Fluke, Model 7405A-4207 (7405A-4207)
DIGITAL MULTIMETER	Range: 20 Hz to 100 kHz, 3 V ac Accuracy: ±0.175%	John Fluke, Model 8506A/CT (p/o MIS-35947)
FREQUENCY COUNTER	Range: 10 Hz to 100 kHz Accuracy: ±0.25%	Hewlett-Packard, Model 5345A (MIS-28754/1 Type 1) w/5355A (5355A)
QUARTZ OSCILLATOR[1]	Range: 5 MHz Accuracy: ±0.25 ppm	Hewlett-Packard, Model 105BOPT908 (105BOPT908)
SPECTRUM ANALYZER[1]	Range: 1 kHz < -75 dBm	Hewlett-Packard, Model 3585A (MIS-35951)

[1]Used only for adjustments.

6. Preliminary Instructions

a. The instructions outlined in paragraphs **6** and **7** are preparatory to the calibration process. Personnel should become familiar with the entire bulletin before beginning the calibration.

b. Items of equipment used in this procedure are referenced within the text by common name as listed in table 2.

c. Unless otherwise specified, verify the result of each test, and whenever the test requirement is not met, take corrective action before continuing with the calibration. Adjustments required to calibrate the TI are included in this procedure. Additional maintenance information is contained in the manufacturer's manual for this TI.

d. Unless otherwise specified, all controls and control settings refer to the TI.

7. Equipment Setup and Internal Calibration

WARNING

HIGH VOLTAGE is used or exposed during the performance of this calibration. DEATH ON CONTACT may result if personnel fail to observe safety precautions. REDUCE OUTPUT(S) to minimum after each step within the performance check where applicable.

a. Remove TI top cover and assure A4S1 switch segments are all in the up position as shown in figure 1. Note initial settings (if not up) for return after completion of procedure.

b. Replace top cover and connect TI to a 115 V ac source.

c. Set **LINE** switch to **ON** and allow 1 hour for warmup.

d. Connect calibrator output to **HIGH** and **LOW INPUT** connectors using balanced cable.

NOTE

If cable is not available then connect as shown in figure 2 for this and all future reference to balanced cable.

e. Set calibrator for 3 V at 1 kHz and activate output.

f. Press **LCL INIT** key. Press **FLOAT** key on the **INPUT** side of TI and verify the red float indicator is illuminated.

g. Press **SPCL** key and enter **20** on **DATA ENTRY** keyboard. Allow sufficient time for ac self calibration to complete before continuing.

NOTE

Ac self calibration is being performed. Verify no error codes are displayed on TI.

h. Set calibrator output to standby, disconnect from TI and connect **INPUT LOW** to **INPUT HIGH** using a short cable.

i. Press **SPCL** key and enter **23** on **DATA ENTRY** keyboard. Allow sufficient time for dc zero calibration to complete before continuing.

NOTE

Dc offset self calibration is being performed. Verify no error codes are displayed on TI.

j. Connect calibrator output to **HIGH** and **LOW INPUT** connectors using balanced cable supplied with TI.

k. Set calibrator for 3 V dc and activate output.

l. Press **SPCL** key and enter **24** on **DATA ENTRY** keyboard. Allow sufficient time for dc calibration to complete before continuing.

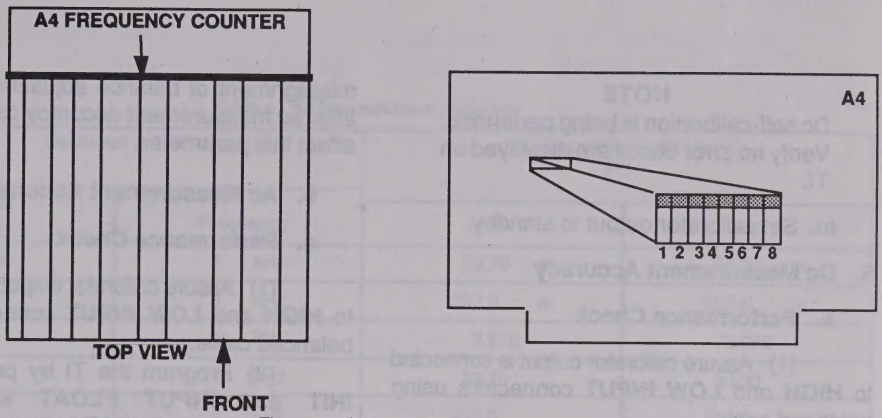

Figure 1. A4S1 - switch location.

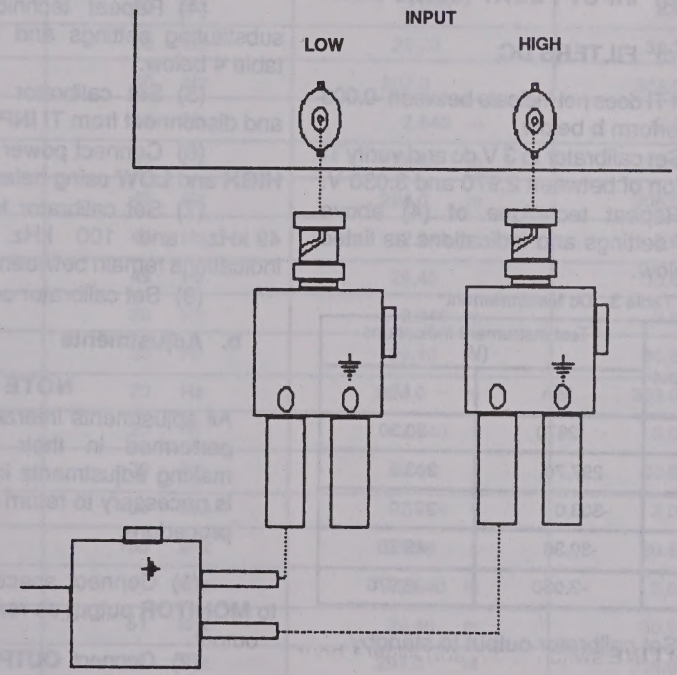

Figure 2. Input connection.

NOTE

Dc self-calibration is being performed. Verify no error codes are displayed on TI.

m. Set calibrator output to standby.

8. Dc Measurement Accuracy

a. Performance Check

(1) Assure calibrator output is connected to **HIGH** and **LOW INPUT** connectors using balanced cable.

(2) Program the TI by pressing keys and entering data as listed in **(a)** through **(c)** below:

(a) LCL INIT.

(b) INPUT FLOAT (assure illumination).

(c) FILTERS DC.

(3) If TI does not indicate between -0.003 and 0.003 perform **b** below.

(4) Set calibrator to 3 V dc and verify TI level indication of between 2.970 and 3.030 V.

(5) Repeat technique of (4) above substituting settings and indications as listed in table 3 below.

Table 3. Dc Measurement

Calibrator output (V dc)	Test instrument indications (V)	
	Min	Max
30	2970	30.30
300	297.70	303.0
-300	-303.0	-297.0
-30	-30.30	-29.70
-3	-3.030	-2.970

(6) Set calibrator output to standby.

b. Adjustments. No specific dc input adjustments can be made; however, misalignment of balance adjustments located after ac measurement accuracy can adversely affect this parameter.

9. Ac Measurement Accuracy

a. Performance Check

(1) Assure calibrator output is connected to **HIGH** and **LOW INPUT** connectors using balanced cable.

(2) Program the TI by pressing **LCL INIT** and **INPUT FLOAT** keys. Verify illumination of the **FLOAT** indicator.

(3) Set calibrator to 3 mV at 1 kHz and verify TI level indication of between 2.970 and 3.030 mV. If indications are not within tolerance, perform **b** below.

(4) Repeat technique of (3) above substituting settings and indications as per table 4 below.

(5) Set calibrator output to standby and disconnect from TI **INPUTS**.

(6) Connect power amplifier to **INPUT HIGH** and **LOW** using balanced cable.

(7) Set calibrator to 300 V at 20 Hz, 49 kHz, and 100 kHz. Verify TI level indications remain between 294.0 and 306.0 V.

(8) Set calibrator output to standby.

b. Adjustments

NOTE

All adjustments interact and must be performed in their entirety. After making adjustments in this section it is necessary to return to beginning of procedure.

(1) Connect spectrum analyzer input to **MONITOR** output on rear of TI.

(2) Connect **OUTPUT HIGH** to **INPUT HIGH** and **LOW** using tee connector and two cables.

Table 4. Ac Measurement Accuracy

Calibrator output		Test instrument indications (V)	
Level (V)	Frequency	Min	Max
.03	1 kHz	29.70 m	30.30 m
.3	1 kHz	297.0 m	303.0 m
3	1 kHz	2.970	3.030
30	1 kHz	29.70	30.30
300	1 kHz	297.0	303.0
.003	50 Hz	2.970 m	3.030 m
.03	50 Hz	29.70 m	30.30 m
.3	50 Hz	297.0 m	303.0 m
3	50 Hz	2.970	3.030
30	50 Hz	29.70	30.30
300	50 Hz	297.0	303.0
.003	49 Hz	2.940 m	3.060 m
.03	49 Hz	29.40 m	30.60 m
.3	49 Hz	294.0 m	306.0 m
3	49 Hz	2.940	3.060
30	49 Hz	29.40	30.60
.003	20 Hz	2.940 m	3.060 m
.03	20 Hz	29.40 m	30.60 m
.3	20 Hz	294.0 m	306.0 m
3	20 Hz	2.940	3.060
30	20 Hz	29.40	30.60
3	100 kHz	2.940	3.060
30	100 kHz	29.40	30.60
.003	51 kHz	2.940 m	3.060 m
.03	51 kHz	29.40 m	30.60 m
.3	51 kHz	294.0 m	306.0 m

(3) Program the TI by pressing keys and entering data as listed in **(a)** through **(g)** below:

(a) LCL INIT.

(b) INPUT FLOAT (assure illumination).

(c) SPCL.

(d) Enter **28.**

(e) OUTPUT LEVEL.

(f) Enter **3 V.**

(g) INPUT LEVEL.

(4) Adjust spectrum analyzer controls to observe a 1 kHz signal.

(5) Alternately adjust A0R29 and A0C35 (fig. 3) for minimum indication on spectrum analyzer (R).

(6) Press **SPCL** key, enter **27**, and adjust A0R12 (fig. 3) for minimum indication on spectrum analyzer.

(7) If <-75-dB was not achieved in (5) or (6) above then alternately adjust A0C5, A0C10, and A0R12 (fig. 3) for minimum indication on spectrum analyzer (R).

(8) Press **SPCL** key and enter **26** on **DATA ENTRY** keyboard.

(9) Adjust A0R7 (fig. 3) for minimum indication on spectrum analyzer (R).

(10) If <-75-dB was not achieved in (8) above then alternately adjust A0C32, A0C33, and A0R7 (fig. 3) for minimum indication on spectrum analyzer (R).

(11) Disconnect spectrum analyzer from equipment setup.

(12) Disconnect **OUTPUT HIGH** from **INPUT HIGH** and **LOW.**

(13) Connect **OUTPUT HIGH** to **INPUT HIGH** and connect **OUTPUT LOW** to **INPUT LOW.**

(14) Program the TI by pressing keys and entering data as listed in **(a)** through **(l)** below:

(a) LCL INIT.
(b) OUTPUT LEVEL.
(c) Enter **3 V.**
(d) OUTPUT FREQ.
(e) Enter **100000 Hz.**
(f) INPUT FLOAT (assure illumination).
(g) SPCL.
(h) Enter **17.**
(I) Enter **28.**
(J) RATIO.
(k) SPCL.
(l) Enter **27.**

(15) Adjust A0C5 (fig. 3) for a 100.0 percent indication on TI (R).

16) Press **SPCL** key and enter **26** on **DATA ENTRY** keyboard.

(17) Adjust A0C32 (fig. 3) for a 100.0 percent indication on TI (R).

(18) Reverse **INPUT HIGH** and **LOW** connections and repeat (13) above.

(19) Adjust A0C10 (fig. 3) for a 100.0 percent indication on TI (R).

(20) Press **SPCL** key and enter **26** on **DATA ENTRY** keyboard.

(21) Adjust A0C33 (fig. 3) for a 100.0 percent indication on TI (R).

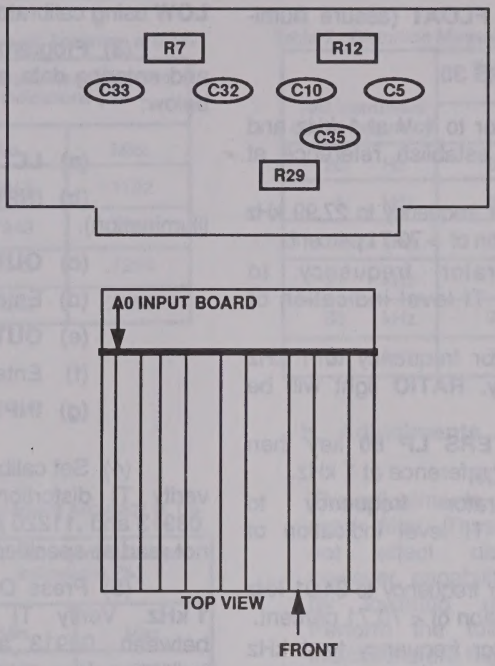

Figure 3. Input board - adjustment locations.

10. Frequency Sensitivity

a. Performance Check

(1) Assure calibrator output is connected to **HIGH** and **LOW INPUT** connectors using balanced cable and connect **LOW INPUT** to chassis ground.

(2) Program the TI by pressing keys as listed in **(a)** through **(c)** below.

(a) LCL INIT.

(b) INPUT FLOAT (assure illumination).

(c) INPUT FREQ.

(3) Set calibrator to 1 mV at 100 Hz then slowly increase calibrator level until TI indicates a stable display of 100 Hz.

(4) Output level of calibrator will be 5 mV or less.

(5) Repeat technique of (3) and (4) above substituting output frequencies and TI indications of 1 and 100 kHz.

b. Adjustments. No adjustments can be made.

11. Filters Frequency Accuracy

a. Performance Check

(1) Assure calibrator output is connected to **HIGH** and **LOW INPUT** connectors using balanced cable.

(2) Program the TI by pressing keys and entering data as listed in **(a)** through **(c)** below:

(a) **LCL INIT.**

(b) **INPUT FLOAT** (assure illumination).

(c) **FILTERS 30.**

(3) Set calibrator to 1 V at 1 kHz and press **RATIO** key to establish reference at 1 kHz.

(4) Set calibrator frequency to 27.99 kHz and verify TI level indication of > 70.71 percent.

(5) Set calibrator frequency to 32.01 kHz and verify TI level indication of < 70.71 percent.

(6) Set calibrator frequency to 1 kHz and press **RATIO** key. **RATIO** light will be extinguished.

(7) Press **FILTERS LP 80** key then **RATIO** key to establish reference at 1 kHz.

(8) Set calibrator frequency to 75.99 kHz and verify TI level indication of > 70.71 percent.

(9) Set calibrator frequency to 84.01 kHz and verify TI level indication of < 70.71 percent.

(10) Set calibrator frequency to 1 kHz and press **RATIO** key. **RATIO** light will be extinguished.

(11) Press **FILTERS LP 220** key then **RATIO** key to establish reference at 1 kHz.

(12) Set calibrator frequency to 199.9 kHz and verify TI level indication of > 70.71 percent.

(13) Set calibrator frequency to 240.1 kHz and verify TI level indication of < 70.71 percent.

(14) Set calibrator output to standby.

b. Adjustments. No adjustments can be made.

12. Distortion Measurement Accuracy

a. Performance Check

(1) Connect **OUTPUT HIGH** to **INPUT HIGH** using short shielded cable.

(2) Connect calibrator output to **INPUT LOW** using calibrator AC divider (1000:1).

(3) Program the TI by pressing keys and entering data as listed in **(a)** through **(g)** below:

(a) **LCL INIT.**

(b) **INPUT FLOAT** (assure illumination).

(c) **OUTPUT FREQ.**

(d) Enter **20 Hz.**

(e) **OUTPUT LEVEL.**

(f) Enter **1 V.**

(g) **INPUT DIST.**

(4) Set calibrator to 1 V at 222 Hz and verify TI distortion indication of between .08913 and .11220 percent. If indication does not read as specified, perform **b** below.

(5) Press **OUTPUT FREQ** and enter **1 kHz.** Verify TI distortion indication of between .08913 and .11220 percent. If indication does not read as specified, perform **b** below.

(6) Repeat technique of (5) above substituting settings and tolerances as indicated in table 5 below.

(7) Set calibrator for 10 V at 222 Hz and repeat technique of (5) above substituting settings and tolerances as indicated in table 6 below.

(10) Set calibrator output to standby and remove ac divider from equipment hookup.

(11) Connect calibrator output to **INPUT LOW** connector.

(12) Set calibrator output for .1 V at 222 Hz and repeat technique of (5) above substituting settings and tolerances as indicated in table 7 below.

(13) Set calibrator output to standby.

Table 5. Distortion Measurement Accuracy at 0.1%

Test instrument output frequency (kHz)	Test instrument distortion indications (%)	
	Min	Max
19.99	.08913	.1122
21	.07943	.1259
50	.07943	.1259
100	.07943	.1259

Table 6. Distortion Measurement Accuracy at 1%

Test instrument output frequency	Test instrument distortion indications (%)	
	Min	Max
20 Hz	.8913	1.1220
1 kHz	.8913	1.1220
19.99 kHz	.8913	1.1220
21 kHz	.7943	1.2590
50 kHz	.7943	1.2590
100 kHz	.7943	1.2590

Table 7. Distortion Measurement Accuracy at 10%

Test instrument output frequency	Test instrument distortion indications (%)	
	Min	Max
20 Hz	8.913	11.220
1 kHz	8.913	11.220
19.99 kHz	8.913	11.220
21 kHz	7.943	12.590
50 kHz	7.943	12.590
100 kHz	7.943	12.590

b. Adjustments

NOTE

The adjustments provided are for the notch filter. These adjustments will not effect distortion accuracy however, capability will be enhanced by lowering residual distortion. Perform the following only if TI indications are high.

(1) Connect **OUTPUT HIGH** to **INPUT HIGH** and **OUTPUT LOW** to **INPUT LOW**.

(2) Press **LCL INIT** and **OUTPUT LEVEL** keys.

(3) Enter **3 V** on **DATA ENTRY** keyboard and press **DIST** key.

(4) Adjust A2R57 and A2R58 (fig. 4) for minimum distortion indication on TI.

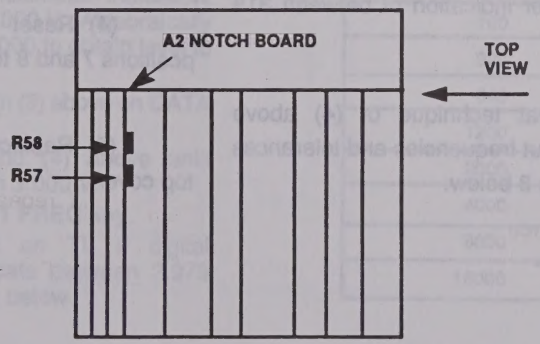

Figure 4. Distortion measurement - adjustment locations.

13. Output Frequency Accuracy

a. Performance Check

(1) Connect frequency counter to **OUTPUT HIGH** and adjust counter for stable display.

(2) Program the TI by pressing keys and entering data as listed in **(a)** through **(e)** below:

(a) LCL INIT.

(b) OUTPUT LEVEL.

(c) Enter **1 V.**

(d) OUTPUT FREQ.

(e) Enter **21.111 Hz.**

(3) If frequency counter does not indicate between 20.900 and 21.322 Hz perform **b** below.

(4) Enter **322.22 Hz** and verify frequency counter indication of between 319 and 325.44 Hz.

(5) Repeat technique of (4) above substituting output frequencies and tolerances indicated in table 8 below.

Table 8. Output Frequency Accuracy

Test instrument frequency (Hz)	Frequency counter indications (Hz)	
	Min	Max
433.33	429	437.66
5444.4	5390	5499
6555.5	6490	6621
76666	75899	77433
87777	86899	88655
98888	97899	99877
99999	98999	100999

b. Adjustments

(1) Connect quartz oscillator 5 MHz output to rear panel **X CLOCK** input.

(2) Remove top cover and set A4S1 (fig. 5) switch positions 7 and 8 to open (down) and press **LCL INIT** key.

(3) Remove cover screw from A5Y1 (fig. 5) and adjust internal slotted screw for a TI indication of 5000.00 kHz (R).

(4) Reset A4S1 (fig. 5) switch positions 7 and 8 to the closed (up) position.

(5) Replace A5Y1 cover screw and TI top cover.

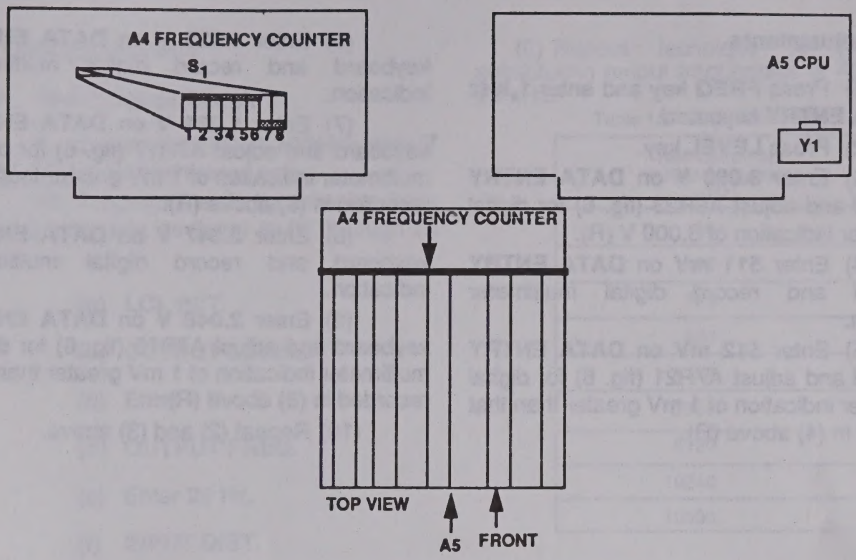

Figure 5. Time base accuracy - adjustment locations.

14. Output Flatness

a. Performance Check

(1) Connect **OUTPUT HIGH** to digital multimeter input set to measure approximately 3 V ac.

(2) Program the TI by pressing keys and entering data as listed in (a) through (c) below:

(a) LCL INIT.

(b) OUTPUT LEVEL.

(c) Enter **3 V.**

(3) Note digital multimeter indication. Subtract indication from 3.000 V. Algebraically add previous result and 3.000 to obtain level to be entered in next step.

(4) Enter value from (3) above on **DATA ENTRY** keyboard.

(5) Repeat (3) and (4) above until digital multimeter indicates 3.000 V.

(6) Press **OUTPUT FREQ** key.

(7) Enter **20 Hz** on TI. If digital multimeter does not indicate between 2.979 and 3.021 V ac, perform **b** below.

(8) Repeat technique of (7) above substituting TI output frequencies as listed in table 9 below.

(9) Repeat technique of (7) above for TI output frequencies 32000, 64000, and 100000 Hz. Digital multimeter will indicate between 2.925 and 3.075 V ac.

Table 9. Output Flatness Frequencies

Test instrument output frequency (Hz)
40
80
160
320
640
1200
2000
4000
8000
16000

b. Adjustments

(1) Press **FREQ** key and enter **1 kHz** on **DATA ENTRY** keyboard.

(2) Press **LEVEL** key.

(3) Enter **3.000 V** on **DATA ENTRY** keyboard and adjust A6R23 (fig. 6) for digital multimeter indication of 3.000 V (R).

(4) Enter **511 mV** on **DATA ENTRY** keyboard and record digital multimeter indication.

(5) Enter **512 mV** on **DATA ENTRY** keyboard and adjust A7R21 (fig. 6) for digital multimeter indication of 1 mV greater than that recorded in (4) above (R).

(6) Enter **1.023 V** on **DATA ENTRY** keyboard and record digital multimeter indication.

(7) Enter **1.024 V** on **DATA ENTRY** keyboard and adjust A7R17 (fig. 6) for digital multimeter indication of 1 mV greater than that recorded in (6) above (R).

(8) Enter **2.047 V** on **DATA ENTRY** keyboard and record digital multimeter indication.

(9) Enter **2.048 V** on **DATA ENTRY** keyboard and adjust A7R15 (fig. 6) for digital multimeter indication of 1 mV greater than that recorded in (8) above (R).

(10) Repeat (2) and (3) above.

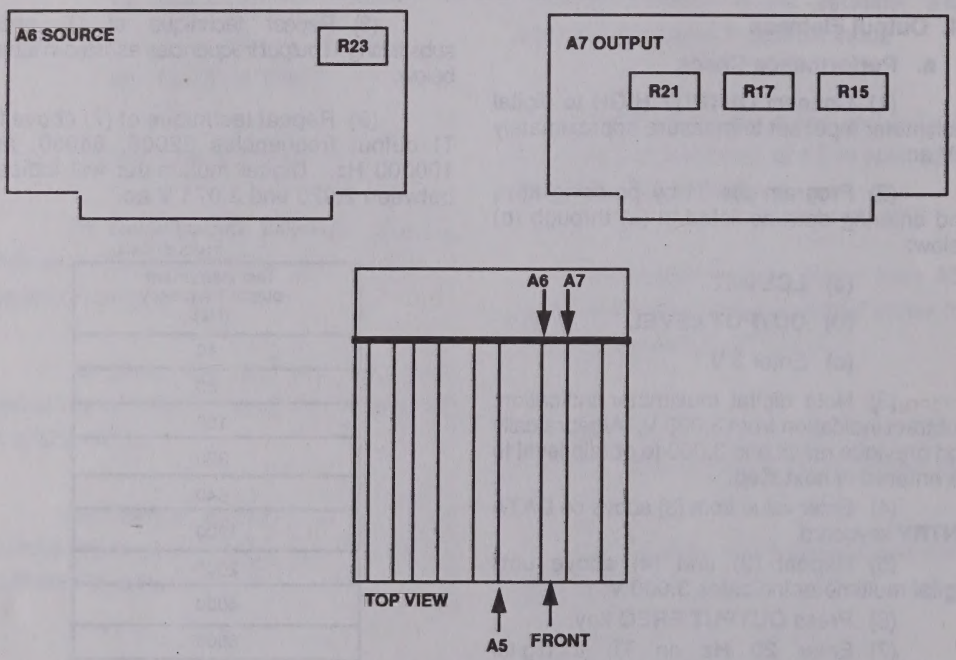

Figure 6. Output level - adjustment locations.

15. Output Distortion

a. Performance Check

(1) Connect **OUTPUT HIGH** to **INPUT HIGH** using a short shielded cable.

(2) Program the TI by pressing keys and entering data as listed in **(a)** through **(f)** below:

(a) LCL INIT.

(b) OUTPUT LEVEL.

(c) Enter **3 V.**

(d) OUTPUT FREQ.

(e) Enter **20 Hz.**

(f) INPUT DIST.

(3) If TI distortion indication is not < .01 percent perform **b** below.

(4) Press **OUTPUT FREQ** key.

(5) Enter **40 Hz** on **DATA ENTRY** keyboard. If TI distortion indication is not < .01 percent, perform **b** below.

(6) Repeat technique of (5) above substituting output frequencies specified by table 10.

(7) Press **OUTPUT FREQ** and enter **21 kHz**. If TI distortion indication is not < .056 percent, perform **b** below.

(8) Repeat technique of (6) above substituting output frequencies of 42, 84, and 99 kHz.

Table 10. Output Distortion

Test instrument output frequency (Hz)
80
160
320
640
1280
2560
5120
10240
19990

b. Adjustments. No specific adjustments are provided for the output circuitry of TI. The adjustments listed in paragraph **12**, Distortion Measurement Accuracy, could cause a failure of this test. If distortion indications are only slightly high perform paragraph **12b** then perform paragraphs **12a** and **15**.

16. Final Procedure

a. Deenergize and disconnect all equipment. Return switch settings to original positions.

b. Annotate and affix DA Label/Form in accordance with TB 750-25.

By Order of the Secretary of the Army:

GORDON R. SULLIVAN
General, United States Army
Chief of Staff

Official:

MILTON H. HAMILTON
Administrative Assistant to the
Secretary of the Army
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